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etching or polishing a surface of the covering layer until a surface of the upper resist pattern is exposed, thereby allowing the covering layer to selectively remain in an open portion of the upper resist pattern; and

etching the upper resist pattern and the lower resist film to form a lower resist pattern, using the covering layer remaining in the open portion as a mask.

IN THE DRAWINGS:

Subject to the approval of the Examiner, Applicant proposes changing Figs. 1A-1F, 2B, 2F, and 3E, to add the legend -- Prior Art -- to Figs. 1A-1F, and add reference characters not found in Figs. 2B, 2F, and 3E. A Request for Approval of Drawing Changes indicating such changes is filed concurrently herewith.

REMARKS

In the present Amendment, Applicant has canceled claims 1, 5, 7, 8, 11, 15, 17, 18, and 20, without prejudice or disclaimer of the subject matter thereof. Applicant has amended claims 2, 6, 9, 10, 12, 16, and 19, and added new claims 21-23 to more appropriately define aspects of the invention. No new matter has been added. Applicant is also filing concurrently herewith a Request for Approval of Drawing Changes requesting approval of changes to Figs. 1A-1F, 2B, 2F, and 3E. Upon entry of the Amendment, claims 2-4, 6, 9, 10, 12-14, 16, 19, and 21-23 are pending.

In the Office Action, the Examiner required corrections to the drawings in reply to the objections he made. The Examiner rejected claims 1-6 and 20 under 35 U.S.C. § 102(a) as being anticipated by Yasuda et al. (JP-411283910); rejected claims 1-9 and 20 under 35 U.S.C. § 103(a) as being unpatentable over Yoko (JP-7-135140) in view of Novembre (U. S. Patent No. 5,066,566); and rejected claims 10-19 under 35 U.S.C. §

FINNEGAN
HENDERSON
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DUNNER LLP

1300 I Street, NW
Washington, DC 20005
202.408.4000
Fax 202.408.4400
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103(a) as being unpatentable over Yoko in view of Novembre, and further in view of May et al. (U. S. Patent No. 5,950,106).

As requested by the Examiner, Applicant proposes making changes to the drawings to add the legend -- Prior Art -- to Figs. 1A-1F, and add reference characters not found in Figs. 2B, 2F, and 3E, as indicated in the Request for Approval of Drawing Changes filed herewith. Applicant submits that the objections to the drawings have been overcome by the these changes.

Applicant submits that the rejections of claims 1, 5, 7, 8, 11, 15, 17, 18, and 20 under 35 U.S.C. §§ 102(a) and 103(a) are rendered moot, in view of the cancellation of these claims in the present Amendment.

Applicant respectfully traverses the rejection of claims 2-4 and 6 under 35 U.S.C. § 102(a) as being anticipated by Yasuda et al., because Yasuda et al. does not teach each and every element of new independent claim 21, from which claims 2-4 and 6 depend.

Referring to Yasuda et al., paragraphs [0018]-[0024] of the translated version thereof, and also as shown in Figs. 2a-2f, "[a] 1st resist 1 . . . is applied . . . on a semiconductor substrate [3], . . . projection exposure [is carried out] using [a] mask containing a pattern [to form a pattern 1a of the 1st resist 1,] . . . [a] 2nd resist material . . . [is applied] to 1st resist pattern 1a on the semiconductor substrate 3[,] . . . the semiconductor substrate 3 is heat-treated[,] . . . [and then] development ablation of the 2nd resist 2 . . . is carried out".

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1300 I Street, NW
Washington, DC 20005
202.408.4000
Fax 202.408.4400
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Clearly, Yasuda et al. only teaches forming a first resist and a second resist. It does not teach at least "forming a lower resist film . . . ; forming an upper resist film . . . ; forming a covering layer . . . ; etching or polishing a surface of the covering layer. . . ; and etching the upper resist pattern and the lower resist film to form a lower resist pattern", as recited in new independent claim 21. Therefore, new independent claim 21 is allowable under 35 U.S.C. § 102(a).

Amended claims 2-4 and 6, which depend from claim 21, are therefore also allowable at least because of their dependency from an allowable base claim.

Regarding the rejection of claims 2-4, 6, and 9 under 35 U.S.C. § 103(a) as being unpatentable over Yoko in view of Novembre, Applicant submits that Yoko and Novembre, taken individually or in combination, fail to teach or suggest each and every element of these claims. They at least fail to teach or suggest each and every element of new claim 21, from which claims 2-4, 6, and 9 depend.

Claim 21 recites, among other things, "forming a lower resist film over a surface of a substrate; forming an upper resist film over a surface of the substrate; patterning the upper resist film to form an upper resist pattern; [and] forming a covering layer containing silicon or a metal on the upper resist pattern by a coating method using a solution containing water as a solvent which is incapable of dissolving said upper resist pattern".

According to the figures and paragraphs [0012]-[0014] of the translation of Yoko provided by the Examiner, "a novolak system resist . . . as a lower layer resist 2 . . . [is formed] on the substrate 1[,] . . . an electron beam resist . . . as an upper resist 4 [is formed on lower layer resist 2,] . . . [a] reverse pattern [7 of upper resist 4]. . . is

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HENDERSON
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1300 I Street, NW
Washington, DC 20005
202.408.4000
Fax 202.408.4400
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formed[,] . . . [an] organic . . . ([trade name:] OCD T-7 6000-R) . . . as an upper shell SOG film 8 . . . [is formed on pattern 7 of upper resist 4] . . . [by] spin [coating][,] . . . [e]tchback is carried out by . . . dry etching . . . until the [surface] of [pattern] 7 of the upper resist 4 [is exposed,] . . . [d]evelopment removes [pattern] 7 of the upper resist 4[,] . . . [and] [p]atterning of the lower layer resist 2 is carried out by . . . dry etching . . . by using as a mask the pattern of [SOG film 8]”.

Apparently, in rejecting claims 1-9 and 20 under 35 U.S.C. § 103(a) as being unpatentable over Yoko in view of Novembre, the Examiner considered Yoko’s SOG film as corresponding to Applicant’s claimed covering film. However, the SOG film in Yoko is an organic SOG made by Tokyo Ohka Kogyo Co., Ltd., with the trade name OCD T-7 6000-R. See Paragraph [0013] of Yoko. This SOG film is a formed from a solution containing an organic solvent, rather than “a solution containing water”, as ← recited in claim 21. Therefore, Yoko fails to teach or suggest at least “forming a covering layer . . . by a coating method using a solution containing water as a solvent which is incapable of dissolving said upper resist pattern”, as recited in claim 21. Thus, Yoko actually teaches away from the present invention as recited in claim 21.

The Examiner also stated that the SOG is “a water-soluble polymer” (Office Action, page 4). Applicant notes that the SOG is actually a water-insoluble polymer.

Moreover, as discussed above, Yoko teaches that “[d]evelopment removes [pattern] 7 of the upper resist 4[,] . . . [and] [p]atterning of the lower layer resist 2 is carried out by . . . dry etching . . . by using as a mask the pattern of [SOG film 8]”.

Paragraph [0014] of the translation. Apparently, the removal of upper resist 4 and the patterning of the lower layer resist 2 are two separate steps. In contrast, claim 21

requires "etching the upper resist pattern and the lower resist film to form a lower resist pattern, using the covering layer remaining in the open portion as a mask," which is a single step.

In view of the above, Yoko fails to teach or suggest at least "forming a covering layer . . . by a coating method using a solution containing water as a solvent which is incapable of dissolving said upper resist pattern; . . . and etching the upper resist pattern and the lower resist film to form a lower resist pattern, using the covering layer remaining in the open portion as a mask", as recited in claim 21. Yoko actually teaches away from claim 21.

Novembre only teaches a resist material useful for deep ultraviolet, x-ray, and electron radiation. According to Novembre, a polymer to be coated "is dissolved in a suitable solvent such as ethylethoxypropionate" (col. 5, lines 53-54). Applicant submits that ethylethoxypropionate is an organic solvent, and it actually dissolves a resist. As a result, Novembre actually teaches away from claim 21, which recites, among other things, "forming a covering layer . . . by a coating method using a solution containing water as a solvent which is incapable of dissolving said upper resist pattern". Moreover, Novembre also fails to teach or suggest at least "forming a lower resist film over a surface of a substrate; forming an upper resist film over a surface of the substrate; patterning the upper resist film to form an upper resist pattern; forming a covering layer containing silicon or a metal on the upper resist pattern by a coating method using a solution containing water as a solvent which is incapable of dissolving said upper resist pattern; . . . and etching the upper resist pattern and the lower resist film to form a lower

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DUNNER LLP

1300 I Street, NW
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resist pattern, using the covering layer remaining in the open portion as a mask." Thus, Novembre fails to cure the above-noted deficiencies of Yoko.

Therefore, Applicant submits that claim 21 is patentable over Yoko in view of Novembre.

Claims 2-4, 6, and 9, which depend from claim 21, are therefore also allowable over Yoko in view of Novembre at least because of their dependency from allowable claim 21.

Applicant traverses the rejection of claims 10, 12-14, 16, and 19 under 35 U.S.C. § 103(a) as being unpatentable over Yoko in view of Novembre, and further in view of May et al. Applicant submits that Yoko, Novembre, and May et al., taken individually or in combination, fail to teach or suggest each and every element of those claims.

Regarding the rejection of claim 10, as discussed above, Yoko and Novembre, taken individually or in combination, fail to teach or suggest each and every element of claim 21, from which claim 10 depends.

May et al. discloses a method for patterning an underlying metal substrate, including forming a layer of spin-on glass over the metal substrate, forming a layer of photoresist over the spin-on glass, patterning the photoresist, patterning the spin-on glass using the photoresist as a mask, and patterning the metal substrate. May et al. does not teach or suggest at least "forming a lower resist film over a surface of a substrate; forming an upper resist film over a surface of the substrate; patterning the upper resist film to form an upper resist pattern; forming a covering layer containing silicon or a metal on the upper resist pattern by a coating method using a solution containing water as a solvent which is incapable of dissolving said upper resist pattern;

. . . and etching the upper resist pattern and the lower resist film to form a lower resist pattern, using the covering layer remaining in the open portion as a mask," as required by Applicant's new claim 21. Therefore, May et al. fails to cure the deficiencies of Yoko and Novembre with regard to claim 21.

Therefore, claim 21 is patentable over Yoko, Novembre, and May et al. Claim 10, which depends from claim 21, is also allowable at least because of its dependency from an allowable base claim.

Similarly, new independent claim 22 recites, among other things, "forming a lower resist film over a surface of a substrate; forming an upper resist film over a surface of the substrate; . . . forming a covering layer containing silicon or a metal on the upper resist pattern by a coating method using a solution containing water as a solvent which is incapable of dissolving said upper resist pattern; . . . and etching the upper resist pattern and the lower resist film to form a lower resist pattern, using the covering layer remaining in the open portion as a mask, wherein said forming of said covering layer and said wet-etching are continuously performed using an apparatus provided with a coater and a wet etcher." Yoko, Novembre, and May et al., taken individually or in combination, fail to teach or suggest at least these features.

Therefore, claim 22 is patentable over Yoko, Novembre, and May et al., and claims 12-14, 16, and 19, which depend from claim 22, are also allowable at least because of their dependency from an allowable base claim.

Finally, new independent claim 23 is directed to a method of manufacturing a semiconductor device, comprising, among other things, "forming a lower resist film over a surface of a substrate; forming an upper resist film over a surface of the substrate;

. . . forming a covering layer containing silicon or a metal on the upper resist pattern by a coating method using a solution containing water as a solvent which is incapable of dissolving said upper resist pattern; . . . and etching the upper resist pattern and the lower resist film to form a lower resist pattern, using the covering layer remaining in the open portion as a mask." As discussed above, none of Yasuda et al., Yoko, Novembre, and May et al. teaches or suggests at least these elements. Therefore, claim 23 is allowable.

In view of the foregoing remarks, Applicants respectfully request the reconsideration and reexamination of this application and the timely allowance of the pending claims 2-4, 6, 9-10, 12-14, 16, 19, and 21-23.

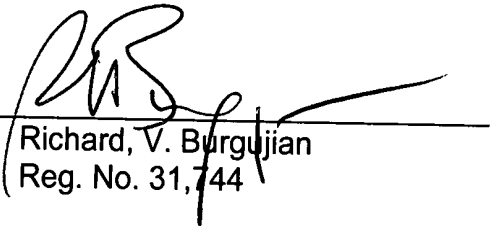
Please grant any extensions of time required to enter this response and charge any additional required fees to our deposit account 06-0916.

Respectfully Submitted,

FINNEGAN, HENDERSON, FARABOW,
GARRETT & DUNNER, L.L.P.

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By: _____


Richard, V. Burgujian
Reg. No. 31,744

FINNEGAN
HENDERSON
FARABOW
GARRETT &
DUNNER LLP

1300 I Street, NW
Washington, DC 20005
202.408.4000
Fax 202.408.4400
www.finnegan.com

APPENDIX TO AMENDMENT FILED MAY 6, 2003

Amended Claims:

2. (Amended) The method according to claim [1] 21, wherein said covering film contains one selected from the group consisting of silicon, Al₁ and Ti.
6. (Amended) The method according to claim [1] 21, which further comprises heating the covering layer.
9. (Amended) The method according to claim [8] 21, wherein said surface of the covering layer is etched by means of reactive ion etching method, or polished by [means of] chemical mechanical polishing method.
10. (Amended) The method according to claim [8] 21, wherein said surface of the covering layer is wet-etched by making use of one selected from the group consisting of water, an acidic aqueous solution₁ and an alkaline aqueous solution.
12. (Amended) The method according to claim [11] 22, wherein said covering film contains one selected from the group consisting of silicon, Al₁ and Ti.
16. (Amended) The method according to claim [11] 22, which further comprises heating the covering layer.
19. (Amended) The method according to claim [11] 22, wherein said surface of the covering layer is wet-etched by making use of one selected from the group consisting of water, an acidic aqueous solution₁ and an alkaline aqueous solution.

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1300 I Street, NW
Washington, DC 20005
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Fax 202.408.4400
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